



## Mines Safety Bulletin No. 84

**Date:** 25 May 2009

**Subject:** Failure of light vehicle steering box shaft

### Introduction

Following a steering box shaft failure on a mine site, an incident investigation report was received by Resources Safety. The root causes of the steering box shaft failure were noted in the investigation.

The incident involved the shearing of a "sector shaft" of a steering box on a Toyota 4WD, resulting in total steering failure and loss of operator control. The sector shaft extends from the steering box with a male spline and is attached to the pitman arm, which is connected to the steering rods, along with the power steering hydraulics.

The investigation found the following.

- Inspection of the failed steering box showed that a worn section of the shaft had been repaired by machining down the shaft and fitting a sleeve. This created a stress point on the shaft that subsequently fractured.
- The shaft failed without warning.
- Thirteen of 38 steering box units checked at the mine site were found to have lathed sector shafts with pressed sleeves installed.
- Of the 13 modified steering box units, two had fatigue failures.

### Discussion

Many of these steering boxes are exposed to heavy duty usage on mine sites and other primary industries such as farming.

When a sector shaft is worn or damaged by normal wear and tear, the seal ring cannot maintain the seal and the steering box leaks oil, leading to mechanical failure within the steering box.

Worn or damaged steering boxes may be returned to the distributors to be overhauled, with some being resold to the general public or industry through the secondhand parts market.

To prevent damage to the steering box, it is possible for a worn sector shaft to be lathed down and fitted with a pressed sleeve to maintain the design diameter and create a good seal for the steering box oil. However, the removal of metal from the sector shaft weakens the shaft and decreases its ability to absorb impact from the steering system. This can lead to metal fatigue and component failure, resulting in loss of operator control of the vehicle.

Further investigation by Resources Safety has found that refurbishment of steering box sector shafts for Toyota Land Cruisers has been common practice for some years.

In addition:

- Toyota steering box units have been interchangeable from one vehicle to another since 1990.
- Toyota increased the diameter of the sector shafts on its steering boxes in 2003, so it is likely that there are two types of the steering box on the market.
- It is almost impossible to trace all reconditioned steering boxes to determine their origin or reseller details.

## Recommendations

- Toyota steering box units should be inspected and serviced by a qualified technician according to the maintenance schedule given by Toyota.
- Toyota steering box units requiring replacement should be replaced by genuine units or parts.
- Given the possibility that these practices are used on similar components for other vehicles, similar precautions should be considered when maintaining or servicing critical steering linkage components on any vehicle.

A handwritten signature in black ink, appearing to read 'S. Ridge'.

Simon Ridge

DIRECTOR, MINES SAFETY BRANCH